PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the PATENT application of)
)
John W. Pettit) Group Art Unit: 2165
)
Application No.: 10/735,707) Examiner: Chih Cheng G. Kao
)
Filing Date: December 16, 2003)
) Atty. Dkt.: 000049-00110
For: DETECTOR USING CARBON NANOTUBE MATERIAL AS COLD CATHODE FOR SYNTHETIC RADIATION SOURCE) Date: August 27, 2007

APPEAL BRIEF TRANSMITTAL

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Attached is a Brief on Appeal. Please charge any fees, including fees for extension of time under 37 C.F.R. § 1.136(a), or credit any overpayment thereof, to Deposit Account No. 23-2185 (000049-00110). A duplicate copy of this sheet is attached.

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
John W. Pettit	Group Art Unit: 2165
Application No.: 10/735,707	Examiner: Chih Cheng G. Kao
Filed: December 16, 2003	Confirmation No.: 8831
For: DETECTOR USING CARBON NANOTUBE MATERIAL AS COLD CATHODE FOR SYNTHETIC RADIATION SOURCE	

BRIEF ON APPEAL

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The present Brief on Appeal is submitted further to the Notice of Appeal filed October 19, 2006, and in response to the Notification of Non-Compliant Appeal Brief mailed June 26, 2007. Please charge any required fees, including any fees for extension of time, to Deposit Account No. 23-2185 (000049-00110), from which the undersigned is authorized to draw.

I. Real Party in Interest

The real party in interest is the inventor, John W. Petit, Ph.D., of Rockville, Maryland.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

Claims 1-95 have been presented for examination. Claims 1-95 are pending, stand finally rejected, and form the subject matter of the present appeal.

IV. Status of Amendments

The Amendment after Final Rejection filed on March 19, 2007, was entered and apparently overcame the objection to claims 76 and 77.

V. Summary of the Claimed Subject Matter

The invention as claimed in claim 1 is directed to an instrument for performing measurement on an object, the instrument comprising: a radiation source for generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9), the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10) and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons (Fig. 4, target 416; page 36, lines 15-17), the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5); and a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22; Fig. 3, detector 308, page 35, lines 21-22).

Claim 2 depends from claim 1 and recites a further limitation of a computing device for receiving the signal and for calculating and outputting, in accordance with the signal, a numerical value representing a property of the object (Fig. 1C, microterminal 120; page 27, lines 10-15).

Claim 3 depends from claim 2 and recites that the property comprises thickness (page 12, lines 13-15).

Claim 4 depends from claim 2 and recites that the property comprises mass per unit area (page 12, lines 13-15).

Claim 5 depends from claim 2 and recites that the computing device is connected to the radiation source to control the radiation source and is programmed to modulate the beam of radiation (page 9, lines 9-12).

Claim 8 depends from claim 5 and recites that the computing device is programmed (i) to modulate the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) to determine, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) to calibrate the detector in accordance with the leakage current (page 16, line 20, through page 17, line 1).

The invention as claimed in claim 13 is directed to an instrument for performing measurement on an object, the instrument comprising: a radiation source for generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9), the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10) and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons (Fig. 4, target 416; page 36, lines 15-17), the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5); a detector, disposed to intercept

the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22; Fig. 3, detector 308, page 35, lines 21-22); and a computing device for receiving the signal and for calculating and outputting, in accordance with the signal, a numerical value representing a property of the object (Fig. 1C, microterminal 120; page 27, lines 10-15), wherein the computing device is connected to the radiation source to control the radiation source and is programmed to modulate the beam of radiation (page 9, lines 9-12).

The invention as claimed in claim 20 is directed to an instrument for performing measurement on a sheet of material, the instrument comprising: a radiation source for generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9), the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10) and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons (Fig. 4, target 416; page 36, lines 15-17), the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5); a roller assembly for moving the sheet of material such that the beam of radiation is incident on the sheet of material and such that the sheet of material moves past the source (page 27, lines 1-2; page 32, lines 4-6); and a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the sheet of material, for detecting the beam of radiation and for outputting a signal representing the beam of radiation (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22).

The invention as claimed in claim 30 is directed to an instrument for performing measurement on a rod-shaped object, the instrument comprising: a radiation source for generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9), the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10) and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons (Fig. 4, target 416; page 36, lines 15-17), the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5); a holder for holding the rod-shaped object in a path of the beam of radiation (page 35, line 19); and a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation (Fig. 3, detectors 306 and 308; page 35, lines 21-22).

The invention as claimed in claim 33 is directed to a method for performing measurement on an object, the method comprising: (a) generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9) by emitting electrons from a carbon nanotube material (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10), causing the electrons to be incident on a target and emitting the beam of radiation from the target (Fig. 4, target 416; page 36, lines 15-17); (b) causing the beam of radiation to be incident on the object (page 26, lines 5-7; page 32, lines 20-21; page 35, lines 19-20; Fig. 3, rod 304 in path of beam B from source 302); (c) detecting the beam of radiation using a solid state detector and outputting a signal (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22; Fig. 3, detector 308, page 35, lines 21-22); and (d) performing the measurement on the object in accordance with the signal to determine a property of the object (page 27, lines 17-19); wherein step (a)

comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 34 depends from claim 33 and recites that the property comprises thickness (page 12, lines 13-15).

Claim 35 depends from claim 33 and recites that the property comprises mass per unit area (page 12, lines 13-15).

Claim 36 depends from claim 33 and recites that step (a) comprises modulating the beam of radiation (page 9, lines 9-12).

Claim 37 depends from claim 36 and recites that step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection (page 9, lines 7-23).

Claim 39 depends from claim 36 and recites that step (a) comprises (i) modulating the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) determining, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) calibrating the detector in accordance with the leakage current (page 16, line 20, through page 17, line 1).

Claim 43 depends from claim 33 and recites that step (c) comprises: receiving a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object (Fig. 3, transmitted beam T; page 35, lines 19-22); and receiving a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object (Fig. 3, side-scattered beams S; page 35, lines 19-22).

The invention defined by claim 49 is directed to a method for performing measurement on an object, the method comprising: (a) generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9) by emitting electrons from a carbon nanotube material (Fig. 4, carbon nanotube

cathode 402; page 36, lines 9 and 10), causing the electrons to be incident on a target and emitting the beam of radiation from the target (Fig. 4, target 416; page 36, lines 15-17); (b) causing the beam of radiation to be incident on the object (page 26, lines 5-7; page 32, lines 20-21; page 35, lines 19-20; Fig. 3, rod 304 in path of beam B from source 302); (c) detecting the beam of radiation and outputting a signal representing the beam of radiation (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22; Fig. 3, detector 308, page 35, lines 21-22); and (d) receiving the signal and calculating and outputting, in accordance with the signal, a numerical value representing a property of the object (page 27, lines 17-19); wherein step (a) comprises modulating and controlling the beam of radiation such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 50 depends from 49 and recites that step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection (page 9, lines 7-23).

Claim 55 depends from claim 49 and recites that step (c) comprises: receiving a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object (Fig. 3, transmitted beam T; page 35, lines 19-22); and receiving a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object (Fig. 3, side-scattered beams S; page 35, lines 19-22).

The invention as recited in claim 61 is directed to a method for performing measurement on a sheet of material, the method comprising: (a) generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9) by emitting electrons from a carbon nanotube material (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10), causing the electrons to be incident on a target and emitting the beam of radiation from the target (Fig. 4, target 416; page 36, lines 15-17); (b) moving the sheet of material such that the beam of radiation is incident on the sheet of

material and such that the sheet of material moves past the target (page 27, lines 1-2; page 32, lines 4-6); (c) detecting the beam of radiation and outputting a signal representing the beam of radiation (Figs. 1A and 1B, detector 102; page 26, lines 9-11; Figs. 2C and 2D, detector 234; page 32, lines 21-22); and (d) receiving the signal and calculating and outputting, in accordance with the signal, a numerical value representing a property of the sheet of material (page 27, lines 17-19); wherein step (a) comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 65 depends from claim 61 and recites that step (a) comprises modulating the beam of radiation (page 9, lines 9-12).

Claim 66 depends from claim 65 and recites that step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection (page 9, lines 7-23).

Claim 69 depends from claim 68 and recites that step (a) comprises (i) modulating the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) determining, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) calibrating the detector in accordance with the leakage current (page 16, line 20, through page 17, line 1).

The invention as recited in claim 72 is directed to a method for performing measurement on a rod-shaped object, the method comprising: (a) generating a beam of radiation (Fig. 4, source 400; page 36, lines 8 and 9) by emitting electrons from a carbon nanotube material (Fig. 4, carbon nanotube cathode 402; page 36, lines 9 and 10), causing the electrons to be incident on a target and emitting the beam of radiation from the target (Fig. 4, target 416; page 36, lines 15-17); (b) holding the rod-shaped object in a path of the beam of radiation (Fig. 3, rod 304 in path of beam B; page 35, line 19); (c) detecting the beam of radiation and outputting a signal

representing the beam of radiation (Fig. 3, detector 308, page 35, lines 21-22); and (d) determining, from the signal, a property of the rod-shaped object (page 27, lines 17-19); wherein step (a) comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 73 depends from claim 72 and recites that step (c) comprises: detecting a first portion of the beam of radiation by using a first detector after the first portion of the beam of radiation has been transmitted through the object (Fig. 3, detector 308; page 35, lines 21 and 22); and detecting a second portion of the beam of radiation by using a second detector after the second portion of the beam of radiation has been side-scattered through the object (Fig. 3, detectors 306; page 35, line 21).

The invention defined by claim 76 is directed to a method for emitting a high-voltage electron beam, the method comprising: (a) emitting electrons from a carbon nanotube cathode (Fig. 4, carbon nanotube cathode 402; page 36, lines 8-10); and (b) accelerating the electrons through magnetic induction to form the high-voltage electron beam (Fig. 4, magnetic field **B** produced by magnetic field coils 412; page 36, lines 13-17); the carbon nanotube cathode being controlled to emit the electrons such that the high-voltage electron beam is stabilized (page 9, lines 3-5).

The invention defined by claim 78 is directed to a device for emitting a high-voltage electron beam, the device comprising: a carbon nanotube cathode for emitting electrons (Fig. 4, carbon nanotube cathode 402; page 36, lines 8-10); and a magnetic field applying device for applying a magnetic field to the electrons to accelerate the electrons through magnetic induction to form the high-voltage electron beam (Fig. 4, magnetic magnetic field coils 412 producing field

B; page 36, lines 13-17); the cold cathode being controlled to emit the electrons such that the high-voltage electron beam is stabilized (page 9, lines 3-5).

The invention defined by claim 80 is directed to a method for emitting a beam of radiation, the method comprising: (a) emitting electrons from a cathode comprising a carbon nanotube material (Fig. 4, carbon nanotube cathode 402; page 36, lines 8-10); and (b) causing the electrons to be incident on a target for emitting the beam of radiation when struck by the electrons (Fig. 4, target 416; page 36, lines 15-18); wherein the target or an intervening layer is selected to narrow a range of output energies of the beam of radiation (Fig. 4, target 416 and attenuating body 422; page 36, lines 18-20); and wherein the cathode is controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 83 depends from claim 80 and recites that the beam of radiation is made incident on an object, backscattered radiation from the object is detected, and the range of output energies is used to distinguish the backscattered radiation from spurious radiation (page 20, lines 16, through page 21, line 2).

Claim 84 depends from claim 83 and recites that the object comprises a substrate with a coating on the substrate, and wherein the backscattered radiation from the object is detected to measure the coating (page 20, lines 22-23).

The invention as defined in 86 is directed to a method for detection of an object comprising a first material and concealed in a second material, the method comprising: (a) generating a beam of radiation by emitting electrons from a carbon nanotube material (Fig. 4, carbon nanotube cathode 402; page 36, lines 8-10), causing the electrons to be incident on a target and emitting the beam of radiation from the target (Fig. 4, target 416; page 36, lines 15-18); (b) causing the beam of radiation to be incident on the object to generate Compton

backscattered radiation (page 22, line 18, through page 23, line 3); (c) detecting the Compton backscattered radiation using a solid state detector and outputting a signal (page 23, lines 3-10); and (d) detecting the object in accordance with the signal (page 23, lines 3-10); wherein the carbon nanotube material is controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized (page 9, lines 3-5).

Claim 87 depends from claim 86 and recites that step (d) is performed in accordance with differences in atomic weights between the first material and the second material (page 22, lines 18-20; page 23, line 1).

Claim 88 depends from claim 87 and recites that the first material comprises an explosive material (page 22, lines 9-11).

Claim 89 depends from claim 88 and recites that the second material comprises soil (page 22, lines 20-23).

Claim 90 depends from claim 88 and recites that the second material comprises a sea bed (page 22, lines 12-13).

Claim 91 depends from claim 87 and recites that the first material comprises metal (page 23, lines 18 and 19).

Claim 92 depends from claim 91 and recites that the second material comprises cement (page 23, lines 19-21).

Claim 93 depends from claim 92 and recites that the object is a reinforcing rod in a cement structure (page 23, lines 18-21).

Claim 94 depends from claim 91 and recites that the object is a metal shaving in a food product (page 24, line 3).

VI. <u>Ground of Rejections to be Reviewed on Appeal</u>

A. The rejection of claims 1, 2, 9, 11, 12, 33, 40, 42-46, and 95 under 35 U.S.C. § 103(a) over *Sturm* in view of *Takahashi et al.*

B. The rejection of claims 3, 4, 10, 17, 20-24, 28, 34, 35, 41, 61-64, 68, 70, and 71 under 35 U.S.C. § 103(a) over *Sturm*, *Takahashi et al.* and *Allport.*

C. The rejection of claims 5-7, 13-16, 18, 19, 25-27, 36-38, 49-58, and 65-67 under 35 U.S.C. § 103(a) as being unpatentable over *Sturm*, *Takahashi et al.*, *Allport,* and *Hell et al.*

D. The rejection of claims 8, 29, 39, and 69 under 35 U.S.C. § 103(a) as being unpatentable over *Sturm*, *Takahashi et al.*, *Allport, Hell et al.* and *Yokhin.*

E. The rejection of claims 30, 31, 72, and 73 under 35 U.S.C. § 103(a) as being unpatentable over *Grodzins et al.* in view of *Takashashi et al.*

F. The rejection of claims 32 and 74 under 35 U.S.C. § 103(a) over *Grodzins et al* in view of *Takahashi, et al* and further in view of *Averitt et al.*

G. The rejection of claims 33, 47, 48, 72 and 75 under 35 U.S.C. § 103(a) over *Torai et al* in view of *Takahashi et al*

H. The rejection of claims 49, 59, and 60 under 35 U.S.C. § 103(a) over *Torai et al.* in view of *Takahashi et al.* and *Yokhin.*

I. The rejection of claims 76-79 under 35 U.S.C. § 103(a) over *Wideröe* in view of *Takashi et al.*

J. The rejection of claims 80-82 under 35 U.S.C. § 103(a) over *Ohno et al.* in view of *Takahashi et al.*

K. The rejection of claims 80 and 83 under 35 U.S.C. § 103(a) over *Meltzer* in view of *Takahashi et al.*

L. The rejection of claims 84 and 85 under 35 U.S.C. § 103(a) over *Meltzer* and *Takahashi et al.* in view of *MacKenzie*.

M. The rejection of claims 86-89 under 35 U.S.C. § 103(a) as being unpatentable over *Faust* in view of *Takahashi et al.* and *Averitt*.

N. The rejection of claim 90 under 35 U.S.C. § 103(a) over *Faust, Takahashi, et al.*, *Averitt*, and *Uhm*.

O. The rejection of claims 91-93 under 35 U.S.C. § 103(a) over *Faust, Takahashi et al* and *Averitt* and further in view of *Norton.*

P. The rejection of claims 91 and 94 under 35 U.S.C. § 103(a) over *Faust*, *Takahashi et al.*, *Averitt*, and *Cambier et al.*

VII. Argument

The Appellant respectfully traverses all of the above grounds of rejection. As will be explained below, none of the combinations of references applied in the Office Action would have resulted in, taught, or suggested the present claimed invention.

A. The rejection of claims 1, 2, 9, 11, 12, 33, 40, 42-46, and 95 under 35 U.S.C. § 103(a) over *Sturm* in view of *Takahashi et al*

The Final Rejection acknowledges that *Sturm* fails to teach or suggest a cold cathode comprising a carbon nanotube material as recited in the present claims. Instead, the Final Rejection cites *Takahashi et al* for that teaching. However, for the reasons set forth below, the Appellant respectfully submits that since *Takahashi et al* does not make up the above-noted deficiency of *Sturm,* the combination of references would not have resulted in, taught or suggested the present claimed invention.

Takahashi et al teaches the use of a carbon nanotube material as a cold cathode for an x-ray generator and teaches that the voltage of the grid or Wehnelt can be varied to control the field emission of electrons from the carbon nanotube. *Takahashi* says that the advantages of this are low power, low temperature, no high current cable that carries the large filament current, no heating and outgassing, sometimes termed seasoning the tube, long lifetime of the cathode and no stringent requirements on the vacuum on the tube.

Very important is that *Takahashi* does not teach that the control over the carbon nanotube field emission can be used to stabilize the x-ray output beam or that this control can be made to be very rapid, at radio frequencies if desired, so that phase locked techniques can be employed if desired to further stabilize the measurement without sacrificing response time of the measurement. Furthermore, *Takahashi* does not teach the use of such a carbon nanotube cold cathode x-ray tube in any type of measuring device, presumably because these advantages were not obvious or not known to be so important to the operation of these devices.

The Final Rejection adds arguments on page 3 that the cold cathode of *Takahashi et al* is "controlled to emit the electrons such that the beam of radiation emitted by the target is necessarily stabilized…." In support, the Examiner cites the description of the first embodiment in column 4, lines 50-53, and column 5, lines 8-14.

In response, the Appellant respectfully submits that, even if *Takahashi et al* is taken to teach stabilization of the beam of radiation, the present claimed invention offers advantages which a person having ordinary skill in the art would not have appreciated from the references, such as improved ability to detect substances which could not be detected by the prior art, so that the combinations of references proposed by the Examiner would not have been obvious.

The Examiner relies on the following passages in the *Takahashi et al* patent:

1. Column 4, line 50: "The takeoff electrode potential is controlled so as to regulate an emitter-emitting electron current (i.e., tube current). The takeoff electrode 18 potential is ordinarily set positive based on the cathode 14 potential to regulate the tube current, while in some cases it may be set negative to restrain the tube current."

The Appellant respectfully submits that the above excerpt from *Takahashi et al* does not provide any mechanism to stabilize the beam current, as in the present invention. Furthermore, it is not enabling because a person skilled in the art would take this statement to mean that the "electrode potential" is maintained, or controlled, at some fixed value, via any one of numerous means known in the art to control a voltage. In fact, the figure to which this excerpt refers to, Figure 1, shows all voltages being set at fixed values indicated by the conventional symbol for a battery or fixed voltage source, items 46, 44 and 42 of Figure 1. The Appellant's assertion is that fixing these voltages does not regulate the electron current. This electrode potential must be dynamically changed according to the command of a feedback loop in which the "beam current" is the quantity being controlled and the electrode potential is the "control signal." To persons skilled in the art of control sciences, a "control signal" is entirely different from the thing that is being controlled. The control signal is the agent of control, not the thing being controlled. Therefore, *Takahashi et al* is not enabling and the description, supported by Figure 1, does not teach anything that would in fact work as stated in this patent. A fixed electrode potential, again as shown in Figure 1 items 46, 44 and 42, would not respond to changes in the beam current in any way to bring about stabilization of the beam current.

The patent examiner furthermore relies on wording in *Takahashi et al* in column 5 lines 9 through 18, "It is required in the X-ray generator ...."

However, that paragraph again teaches the use of fixed voltages that do not and cannot regulate the beam current:

Excerpted from line 11: "to control independently the Wehnelt 12 potential and the takeoff electrode 18 potential with the use of the second power supply 44 and the third power supply 46 respectively."

These fixed power supplies do not provide control action for the beam current. They may be themselves "controlled" so as to maintain their own voltage in a stable manner, but this does not stabilize the beam current.

In the Advisory Action, it is asserted that "the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art ... cannot be the basis for patentability when the differences would otherwise be obvious," but does not cite case law for that assertion. Indeed, the Appellant respectfully submits that that assertion is mistaken. An unexpected advantage is one of the secondary considerations of nonobviousness that are to be considered in determining whether an invention would have been obvious over the prior art. *Texas Instruments Inc. v. U.S. International Trade Commission,* 871 F.2d 1054, 1063, 10 U.S.P.Q.2d 1257, 1264 (Fed. Cir. 1989). Therefore, any unexpected advantages flowing from the claimed invention should be considered.

Also, the Advisory Action argues that one cannot attack references individually where the rejections are based on a combination of references. The Appellant has not done so. With regard to *Hell et al*, neither that reference nor any other is available as prior art only for selected teachings. As a matter of law, it is necessary to consider all teachings of a reference, including those that teach away from the invention. *W. L. Gore & Associates, Inc., v. Garlock, Inc.,* 721 F.2d 1540, 1550, 220 U.S.P.Q. 303, 311 (Fed. Cir. 1983).

In the Advisory Action, it is further alleged, "Controlling the voltage in a stable manner will necessarily stabilize the beam current, since the two are related to each other." That argument has already been dealt with above.

Therefore, the Appellant respectfully submits that the invention fills a long felt need in the art and that no combination of the applied references would have resulted in, taught, motivated, or even vaguely suggested the solution to that need provided by the present claimed invention.

B. The rejection of claims 3, 4, 10, 17, 20-24, 28, 34, 35, 41, 61-64, 68, 70, and 71 under 35 U.S.C. § 103(a) over *Sturm, Takahashi et al.* and *Allport*

Allport teaches a gauge for measuring the thickness or mass per unit area of a sheet using an x-ray beam where continual measurement of both the transmitted and scattered beam are made and their ratio is computed or a beam intensity measurement is made before the beam impinges upon the material and the ratio of this beam intensity to the transmitted and backscattered beam are employed. In all of *Allport's* teachings, ratios of beams are employed to compensate for material composition changes, and this also compensates for x-ray beam intensity changes, which *Allport* does not directly address, but is an outcome of his teachings and is essential for his teachings to work.

The present claimed invention avoids the need for such complexity. As such, the present claimed invention offers an unobvious advantage.

C. The rejection of claims 5-7, 13-16, 18, 19, 25-27, 36-38, 49-58, and 65-67 under 35 U.S.C. § 103(a) as being unpatentable over *Sturm, Takahashi et al., Allport,* and *Hell et al*

US 6,178,226 B1 by Hell et. al. teaches methods of controlling an electron current in an x-ray tube. This is done while the hot filament is still heated and emitting electrons by changing a voltage that blocks the electrons or controls the path of the electrons so that the electrons do not strike the anode target and produce x-rays. The limitation of this procedure is that the drifts inherent in the heated filament hot cathode are not compensated by this form of control. It is merely a way to deflect the beam or otherwise inhibit the x-ray output, but does nothing to stabilize the beam or add accuracy to a measurement that would result from using this technique in an instrument.

Because of the above-noted difficulties of *Takahashi et al* with regard to modulation, that teaching of *Hell et al* is incompatible with the teachings of *Takahashi et al.* Accordingly, the references, far from teaching or suggesting such a combination, actually provide strong teaching away from it.

D. <u>The rejection of claims 8, 29, 39, and 69 under 35 U.S.C. § 103(a) as being unpatentable over *Sturm*, *Takahashi et al.*, *Allport*, *Hell et al.* and *Yokhin*</u>

Since *Yokhin* does not overcome the above-noted deficiencies of the other applied references, the Appellant respectfully submits that this ground of rejection should be reversed as well.

E. <u>The rejection of claims 30, 31, 72, and 73 under 35 U.S.C. § 103(a) as being unpatentable over *Grodzins et al.* in view of *Takashashi et al*</u>

Grodzins teaches only an "inspection," not a quantitative measurement, using coherent scattering of x-rays by material in a container. The teachings of *Grodzins* rely, somewhat analogous to Sturm above, on measuring the energy spectrum of the x-rays that have been coherently scattered by an object within a volume or enclosure for the purpose of determining

the presence of material or objects that generate different x-ray energy spectra from the base or reference spectra of material within the enclosure. This is not a weight or thickness measurement technique and is very crude in this regard, as the object only needs to be big enough to register with the spatial resolution of the position scanning apparatus that this technique relies upon and beyond that only the object's presence or lack of presence is indicated by the instrument. This is therefore termed an inspection device and not a mass or weight measurement device. The spectral differences are used to make the determination as to whether or not an object of interest is present and the difference in the received x-rays as a function of the x-ray energy is independent from the intensity of the x-ray tube's output intensity.

Thus, there is a persistent and unmet need in the art for a simple, reliable solution to the problem of drift. The present claimed invention offers such a solution.

In addition, the arguments above with regard to *Takahashi et al* apply equally well to the present claimed invention.

Therefore, the Appellant respectfully urges reversal of this ground of rejection.

F. The rejection of claims 32 and 74 under 35 U.S.C. § 103(a) over *Grodzins et al* in view of *Takahashi, et al* and further in view of *Averitt et al*

Since *Averitt et al* does not overcome the above-noted deficiencies of the other applied references, the Appellant respectfully urges reversal of this ground of rejection.

G. The rejection of claims 33, 47, 48, 72 and 75 under 35 U.S.C. § 103(a) over *Torai et al* in view of *Takahashi et al*

The deficiencies of *Takahashi et al* have been discussed above. Since *Torai et al* does nothing to overcome them, the Appellant respectfully submits that the present claimed invention would not have been obvious over this combination of references.

H. The rejection of claims 49, 59, and 60 under 35 U.S.C. § 103(a) over *Torai et al.* in view of *Takakashi et al.* and *Yokhin*

As the references have been discussed above, the Appellant respectfully urges reversal of this ground of rejection.

I. The rejection of claims 76-79 under 35 U.S.C. § 103(a) over *Wideröe* in view of *Takahashi et al*

The deficiencies of *Takahashi et al* have been discussed above. *Wideröe* does nothing to overcome those deficiencies. Therefore, the Appellant respectfully submits that the combination of references would not have resulted in, taught or suggested the present claimed invention.

J. The rejection of claims 80-82 under 35 U.S.C. § 103(a) over *Ohno et al.* in view of *Takahashi et al*

The deficiencies of *Takahashi et al* have been discussed above. *Ohno et al* does nothing to overcome those deficiencies. Therefore, the Appellant respectfully submits that the combination of references would not have resulted in, taught or suggested the present claimed invention.

K. The rejection of claims 80 and 83 under 35 U.S.C. § 103(a) over *Meltzer* in view of *Takahashi et al*

The deficiencies of *Takahashi et al* have been discussed above. *Meltzer* does nothing to overcome those deficiencies. Therefore, the Appellant respectfully submits that the combination of references would not have resulted in, taught or suggested the present claimed invention.

L. The rejection of claims 84 and 85 under 35 U.S.C. § 103(a) over *Meltzer* and *Takahashi et al.* in view of *MacKenzie*

Since *MacKenzie* does not overcome the deficiencies of the other two references, the Appellant respectfully urges that this ground of rejection be reversed.

M. <u>The rejection of claims 86-89 under 35 U.S.C. § 103(a) as being unpatentable over *Faust* in view of *Takahashi et al.* and *Averitt*</u>

The deficiencies of *Takahashi et al* have been discussed above. The other applied references do nothing to overcome those deficiencies. Therefore, the Appellant respectfully submits that the combination of references would not have resulted in, taught or suggested the present claimed invention.

N. <u>The rejection of claim 90 under 35 U.S.C. § 103(a) over *Faust, Takahashi, et al., Averitt*, and *Uhm*</u>

As *Uhm* does not overcome the above-noted deficiencies of the other references, the Appellant respectfully urges reversal of this ground of rejection.

O. <u>The rejection of claims 91-93 under 35 U.S.C. § 103(a) over *Faust, Takahashi et al* and *Averitt* and further in view of *Norton*</u>

As *Norton* does not overcome the above-noted deficiencies of the other references, the Appellant respectfully urges reversal of this ground of rejection.

P. <u>The rejection of claims 91 and 94 under 35 U.S.C. § 103(a) over *Faust, Takahashi et al., Averitt*, and *Cambier et al*</u>

As *Cambier et al* does not overcome the above-noted deficiencies of the other references, the Appellant respectfully urges reversal of this ground of rejection.

For all of the reasons set forth above, the Appellant respectfully urges reversal of all grounds of rejection of claims 1-95.

Respectfully submitted,

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VIII. Claims Appendix

The following is a list of the claims involved in the appeal in their current form.

1. An instrument for performing measurement on an object, the instrument comprising:

a radiation source for generating a beam of radiation, the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons, the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized; and

a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation.

2. The instrument of claim 1, further comprising a computing device for receiving the signal and for calculating and outputting, in accordance with the signal, a numerical value representing a property of the object.

3. The instrument of claim 2, wherein the property comprises thickness.

4. The instrument of claim 2, wherein the property comprises mass per unit area.

5. The instrument of claim 2, wherein the computing device is connected to the radiation source to control the radiation source and is programmed to modulate the beam of radiation.

6. The instrument of claim 5, wherein the computing device is programmed to modulate the beam of radiation and to analyze the signal, to achieve phase-locked detection.

7. The instrument of claim 6, wherein the beam of radiation comprises soft x-rays.

8. The instrument of claim 5, wherein the computing device is programmed (i) to modulate the beam of radiation by turning the beam of radiation off and then on while the

instrument operates, (ii) to determine, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) to calibrate the detector in accordance with the leakage current.

9. The instrument of claim 1, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been transmitted through the object.

10. The instrument of claim 1, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been backscattered from the object.

11. The instrument of claim 1, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been side-scattered from the object.

12. The instrument of claim 1, wherein the detector comprises:

a first detector which is positioned relative to the radiation source such that the first detector receives a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object; and

a second detector which is positioned relative to the radiation source such that the second detector receives a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object.

13. An instrument for performing measurement on an object, the instrument comprising:

a radiation source for generating a beam of radiation, the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when

struck by the electrons, the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized;

a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation; and

a computing device for receiving the signal and for calculating and outputting, in accordance with the signal, a numerical value representing a property of the object, wherein the computing device is connected to the radiation source to control the radiation source and is programmed to modulate the beam of radiation.

14. The instrument of claim 13, wherein the computing device is programmed to modulate the beam of radiation and to analyze the signal, to achieve phase-locked detection.

15. The instrument of claim 14, wherein the beam of radiation comprises soft x-rays.

16. The instrument of claim 13, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been transmitted through the object.

17. The instrument of claim 13, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been backscattered from the object.

18. The instrument of claim 13, wherein the radiation source and the detector are positioned relative to each other such that the detector receives the beam of radiation after the beam of radiation has been side-scattered from the object.

19. The instrument of claim 13, wherein the detector comprises:

a first detector which is positioned relative to the radiation source such that the first detector receives a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object; and

a second detector which is positioned relative to the radiation source such that the second detector receives a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object.

20. An instrument for performing measurement on a sheet of material, the instrument comprising:

a radiation source for generating a beam of radiation, the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when struck by the electrons, the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized;

a roller assembly for moving the sheet of material such that the beam of radiation is incident on the sheet of material and such that the sheet of material moves past the source; and

a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the sheet of material, for detecting the beam of radiation and for outputting a signal representing the beam of radiation.

21. The instrument of claim 20, wherein the source and the detector are disposed to be on opposite sides of the sheet of material, such that the beam of radiation is transmitted through the sheet of material.

22. The instrument of claim 21, further comprising a computing device for receiving the signal and for calculating and outputting, in accordance with the signal, a numerical value representing a property of the object.

23. The instrument of claim 22, wherein the property comprises thickness.

24. The instrument of claim 22, wherein the property comprises mass per unit area.

25. The instrument of claim 20, wherein the computing device is connected to the radiation source to control the radiation source and is programmed to modulate the beam of radiation.

26. The instrument of claim 25, wherein the computing device is programmed to modulate the beam of radiation and to analyze the signal, to achieve phase-locked detection.

27. The instrument of claim 26, wherein the beam of radiation comprises soft x-rays.

28. The instrument of claim 22, wherein the detector is a solid state detector.

29. The instrument of claim 28, wherein the computing device is programmed (i) to modulate the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) to determine, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) to calibrate the detector in accordance with the leakage current.

30. An instrument for performing measurement on a rod-shaped object, the instrument comprising:

a radiation source for generating a beam of radiation, the radiation source comprising (i) a cold cathode, comprising a carbon nanotube material, for emitting electrons and (ii) a target, in a path of the electrons emitted by the cold cathode, for emitting the beam of radiation when

struck by the electrons, the cold cathode being controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized;

a holder for holding the rod-shaped object in a path of the beam of radiation; and

a detector, disposed to intercept the beam of radiation after the beam of radiation has been made incident on the object, for detecting the beam of radiation and for outputting a signal representing the beam of radiation.

31. The instrument of claim 30, wherein the detector comprises:

a first detector which is positioned relative to the radiation source such that the first detector receives a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object; and

a second detector which is positioned relative to the radiation source such that the second detector receives a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object.

32. The instrument of claim 31, wherein each of the first detector and the second detector is a solid state detector.

33. A method for performing measurement on an object, the method comprising:

(a) generating a beam of radiation by emitting electrons from a carbon nanotube material, causing the electrons to be incident on a target and emitting the beam of radiation from the target;

(b) causing the beam of radiation to be incident on the object;

(c) detecting the beam of radiation using a solid state detector and outputting a signal; and

(d) performing the measurement on the object in accordance with the signal to determine a property of the object;

wherein step (a) comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized.

34. The method of claim 33, wherein the property comprises thickness.

35. The method of claim 33, wherein the property comprises mass per unit area.

36. The method of claim 33, wherein step (a) comprises modulating the beam of radiation.

37. The method of claim 36, wherein step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection.

38. The method of claim 37, wherein the beam of radiation comprises soft x-rays.

39. The method of claim 36, wherein step (a) comprises (i) modulating the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) determining, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) calibrating the detector in accordance with the leakage current.

40. The method of claim 33, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been transmitted through the object.

41. The method of claim 33, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been backscattered from the object.

42. The method of claim 33, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been side-scattered from the object.

43. The method of claim 33, wherein step (c) comprises:

receiving a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object; and

receiving a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object.

44. The method of claim 33, wherein the object comprises a sheet material.

45. The method of claim 44, wherein the sheet material comprises paper.

46. The method of claim 45, wherein the paper is cigarette paper.

47. The method of claim 33, wherein the object comprises a rod.

48. The method of claim 47, wherein the rod is a cigarette rod.

49. A method for performing measurement on an object, the method comprising:

(a) generating a beam of radiation by emitting electrons from a carbon nanotube material, causing the electrons to be incident on a target and emitting the beam of radiation from the target;

(b) causing the beam of radiation to be incident on the object;

(c) detecting the beam of radiation and outputting a signal representing the beam of radiation; and

(d) receiving the signal and calculating and outputting, in accordance with the signal, a numerical value representing a property of the object;

wherein step (a) comprises modulating and controlling the beam of radiation such that the beam of radiation emitted by the target is stabilized.

50. The method of claim 49, wherein step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection.

51. The method of claim 50, wherein the beam of radiation comprises soft x-rays.

52. The method of claim 49, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been transmitted through the object.

53. The method of claim 49, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been backscattered from the object.

54. The method of claim 49, wherein step (c) comprises receiving the beam of radiation after the beam of radiation has been side-scattered from the object.

55. The method of claim 49, wherein step (c) comprises:

receiving a first portion of the beam of radiation after the first portion of the beam of radiation has been transmitted through the object; and

receiving a second portion of the beam of radiation after the second portion of the beam of radiation has been side-scattered through the object.

56. The method of claim 49, wherein the object comprises a sheet material.

57. The method of claim 56, wherein the sheet material comprises paper.

58. The method of claim 57, wherein the paper is cigarette paper.

59. The method of claim 49, wherein the object comprises a rod.

60. The method of claim 59, wherein the rod is a cigarette rod.

61. A method for performing measurement on a sheet of material, the method comprising:

(a) generating a beam of radiation by emitting electrons from a carbon nanotube material, causing the electrons to be incident on a target and emitting the beam of radiation from the target;

(b) moving the sheet of material such that the beam of radiation is incident on the sheet of material and such that the sheet of material moves past the target;

(c) detecting the beam of radiation and outputting a signal representing the beam of radiation; and

(d) receiving the signal and calculating and outputting, in accordance with the signal, a numerical value representing a property of the sheet of material;

wherein step (a) comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized.

62. The method of claim 61, wherein step (c) comprises detecting the beam of radiation after the beam of radiation is transmitted through the sheet of material.

63. The method of claim 61, wherein the property comprises thickness.

64. The method of claim 61, wherein the property comprises mass per unit area.

65. The method of claim 61, wherein step (a) comprises modulating the beam of radiation.

66. The method of claim 65, wherein step (a) comprises modulating the beam of radiation and analyzing the signal, to achieve phase-locked detection.

67. The method of claim 66, wherein the beam of radiation comprises soft x-rays.

68. The method of claim 61, wherein step (c) is performed using a solid state detector.

69. The method of claim 68, wherein step (a) comprises (i) modulating the beam of radiation by turning the beam of radiation off and then on while the instrument operates, (ii) determining, from the signal received while the beam of radiation is off, a leakage current of the detector, and (iii) calibrating the detector in accordance with the leakage current.

70. The method of claim 68, wherein the sheet of material comprises paper.

71. The method of claim 70, wherein the paper is cigarette paper.

72. A method for performing measurement on a rod-shaped object, the method comprising:

(a) generating a beam of radiation by emitting electrons from a carbon nanotube material, causing the electrons to be incident on a target and emitting the beam of radiation from the target;

(b) holding the rod-shaped object in a path of the beam of radiation;

(c) detecting the beam of radiation and outputting a signal representing the beam of radiation; and

(d) determining, from the signal, a property of the rod-shaped object;

wherein step (a) comprises controlling the carbon nanotube material to emit the electrons such that the beam of radiation emitted by the target is stabilized.

73. The method of claim 72, wherein step (c) comprises:

detecting a first portion of the beam of radiation by using a first detector after the first portion of the beam of radiation has been transmitted through the object; and

detecting a second portion of the beam of radiation by using a second detector after the second portion of the beam of radiation has been side-scattered through the object.

74. The method of claim 73, wherein each of the first detector and the second detector is a solid state detector.

75. The method of claim 72, wherein the rod-shaped object is a cigarette rod.

76. A method for emitting a high-voltage electron beam, the method comprising:

(a) emitting electrons from a carbon nanotube cathode; and

(b) accelerating the electrons through magnetic induction to form the high-voltage electron beam;

the carbon nanotube cathode being controlled to emit the electrons such that the high-voltage electron beam is stabilized.

77. The method of claim 76, wherein step (b) comprises:

(i) causing the electrons to enter a region of a magnetic field; and

(ii) increasing the magnetic field to cause the electrons to gain energy.

78. A device for emitting a high-voltage electron beam, the device comprising:

a carbon nanotube cathode for emitting electrons; and

a magnetic field applying device for applying a magnetic field to the electrons to accelerate the electrons through magnetic induction to form the high-voltage electron beam;

the cold cathode being controlled to emit the electrons such that the high-voltage electron beam is stabilized.

79. The device of claim 78, wherein the magnetic field applying device comprises a controller for increasing the magnetic field to cause the electrons to gain energy.

80. A method for emitting a beam of radiation, the method comprising:

(a) emitting electrons from a cathode comprising a carbon nanotube material; and

(b) causing the electrons to be incident on a target for emitting the beam of radiation when struck by the electrons;

wherein the target or an intervening layer is selected to narrow a range of output energies of the beam of radiation; and

wherein the cathode is controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized.

81. The method of claim 80, wherein the beam of radiation is made incident on an object to make a stabilized measurement of a characteristic of the object.

82. The method of claim 80, wherein the beam of radiation is made incident on an object, and wherein the range of output energies is selected to select a fluorescence emission of a material in the object.

83. The method of claim 80, wherein the beam of radiation is made incident on an object, backscattered radiation from the object is detected, and the range of output energies is used to distinguish the backscattered radiation from spurious radiation.

84. The method of claim 83, wherein the object comprises a substrate with a coating on the substrate, and wherein the backscattered radiation from the object is detected to measure the coating.

85. The method of claim 84, wherein the coating comprises paint.

86. A method for detection of an object comprising a first material and concealed in a second material, the method comprising:

(a) generating a beam of radiation by emitting electrons from a carbon nanotube material, causing the electrons to be incident on a target and emitting the beam of radiation from the target;

(b) causing the beam of radiation to be incident on the object to generate Compton backscattered radiation;

(c) detecting the Compton backscattered radiation using a solid state detector and outputting a signal; and

(d) detecting the object in accordance with the signal;

wherein the carbon nanotube material is controlled to emit the electrons such that the beam of radiation emitted by the target is stabilized.

87. The method of claim 86, wherein step (d) is performed in accordance with differences in atomic weights between the first material and the second material.

88. The method of claim 87, wherein the first material comprises an explosive material.

89. The method of claim 88, wherein the second material comprises soil.

90. The method of claim 88, wherein the second material comprises a sea bed.

91. The method of claim 87, wherein the first material comprises metal.

92. The method of claim 91, wherein the second material comprises cement.

93. The method of claim 92, wherein the object is a reinforcing rod in a cement structure.

94. The method of claim 91, wherein the object is a metal shaving in a food product.

95. The instrument of claim 1, wherein the detector comprises a solid state detector.

IX. Evidence Appendix

No evidence is relied upon in the present appeal.

X. Related Proceedings Appendix

There are no related proceedings.